

# Are we Ready for a Second Nuclear Era?

Marcel Coderch

Just a few years ago everything seemed ready for a Second Nuclear Era, a new start for nuclear power, as Alvin M. Weinberg, one of the most distinguished nuclear pioneers, had argued for back in 1985 after recognition that the First Nuclear Era had waned due to a combination of overpromises, mistakes in reactor technology selection, complexity and safety problems inherent to the LWR design, rising capital costs, cost overruns and high interest rates, modest growth of electricity demand, unresolved waste issues and negative public attitude after the Three Mile Island accident. In his memoirs, published in 1994, he asked himself how could he have been so stupid to accept what turned out to be impossibly optimistic cost estimates, and confessed that it was because the tiny group who started nuclear energy back in the 50s' wanted to believe that they had encountered a great technical boon for humanity, a symbol of a new, technologically oriented civilization, the "ultimate technological fix", that would forever eliminate quarrels over scarce raw materials.

However, even confessing that he had been very wrong assuming that the first 50 years of nuclear power would usher in H.G. Wells's World Set Free, he still believed in the rebirth of nuclear energy, in a second nuclear era in which the full potential of the technology would be realized, asking to be pardoned for his past mistakes if nuclear engineers eventually figured out how to build real reactors, not only paper ones, that meet the prices listed in GE catalog of 1964.

In 1981, the Institute for Energy Analysis, a division of the Oak Ridge Associated Universities, obtained a grant from the Mellon Foundation to investigate technical approaches that might restore the confidence in nuclear power that had been shattered by the TMI accident. A team headed by Weinberg produced a study over a two-year period which sought to determine what it would take to usher the Second Nuclear Era they firmly believed in. The conclusions they reached are revealing and they suggest that the so called Nuclear Renaissance is unlikely to succeed, because most of the problems then identified are still waiting for real, not paper solutions, as Weinberg liked to say.

For example, in terms of security, they realized that the post-TMI  $10^{-4}$  core-melt probability per reactor-year proposed by the NRC for a world of 500 reactors, would be unacceptably high if there were to be a significant expansion of nuclear capacity. Thus, it was necessary to improve the safety of new generation reactors by an order of magnitude with an increase in capital costs not higher than 20% with respect to second generation LWRs. For this reason, they proposed the development of "inherently safe reactors" whose safety would not depend on device intervention.

Next, they concluded that there would be no Second Nuclear Era unless the costs of nuclear power were kept under control and judged reliably before construction begun. They suggested reduced labor contents through standard designs and reduced interest and cost escalation through improved construction schedules and the use of standard commercial equipment and construction practices. On the regulatory side, they suggested that the NRC should not change regulations during construction, even though

they were not prepared to say that incrementally improved LWRs can be proved in advance to have no deficiencies that would be revealed only after construction had begun.

Assurance of fuel supply, waste disposal and siting were also seen as central to the long term future of nuclear energy, concluding that assurance of fuel supply could once more become a pressing concern. In spite of that, the capital costs of breeders were seen as precluding its commercial deployment and favoring such speculative possibilities was considered unjustified. As for nuclear waste, they recommended “imaginative inducements”, including liberal financial ones, to be offered to states and localities designated for disposal sites. They believed that the irradiated fuel should continue to be stored for a long time (50 to 100 years) at the reactor site prior to permanent disposal, so as to reduce transport risk and potential overheating of the permanent waste repository.

They expressed their hope that an LWR adequate for a Second Nuclear Era could be available well before the year 2000, but were unconvinced that a laissez-faire approach would provide an adequate range of options or that it is an optimal course of action for reactor development and deployment. They concluded their future outlook by asserting that the overall leadership would have to come from the government, as the political encumbrances of nuclear power have hindered the private sector from taking over leadership as they have done in the oil business.

By comparing what Weinberg and his colleagues had to say about the prerequisites for a new nuclear era with what is currently available to feed the “nuclear renaissance”, one can easily lead to the conclusion that almost none of these prerequisites has been satisfied by the nuclear industry, and that therefore it is unlikely that such a renaissance can materialize in a significant number of reactors worldwide.

In fact, after 22 applications for new reactor licenses were brought to the NRC for consideration by the end of 2008, in 2009 only one application was added to the queue and none so far this year. In the last few months the would-be builders of seven of these reactors have deferred their projects and some others have definitely cancelled them, mostly because the economics have swung against nuclear. Weak power demand and competitive electricity markets, together with a surge in US production of shale natural gas, have raised the prospect that electricity prices will be held down for many years to come with gas generation competitively advantaged.

The new generation reactor that on paper most closely matches Weinberg’s prerequisites for a second nuclear era, the Evolutionary Power Reactor (EPR), has evidenced how difficult it still is to make a reactor sufficiently safe and at the same time affordable. The failure to meet economic and construction-period targets at Olkiluoto and Flamanville has heavily weighted against this French offer to the world. Their loss of the large United Arab Emirates contract to the benefit of a South Korean cheaper, generation II, reactor has had a heavy impact on the French nuclear sector and government. The unilateral break of their US venture by Constellation Energy after failing to obtain a US government loan-guarantee on acceptable terms has dealt a fatal blow to EDF plans to enter the US market. In UK a question is being repeatedly asked with none answering: can nuclear energy be developed without government subsidies? Only in China it seems that nuclear constructions are going ahead without much consideration for markets, financial or otherwise.

All together, it seems unlikely that we will hurry into a second nuclear era, at least for the time being, and Weinberg, who thought that an LWR adequate for such an era ought to be available well before the year 2000, would be very disappointed to see that his old mistakes are being repeated again and again and, were he alive, he would again be lead to recognize his mistaken optimism and possibly ask once more for pardon.